

SECTION 16470
DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

0.1 DESCRIPTION OF WORK

- A.** Work Included: This Section specifies furnishing and installing distribution switchboards.
- B.** Related work. This work includes sections 16050 and 16450.

0.2 SUBMITTALS

- A.** Shop Drawings. Submit shop drawings including:
 1. Single line diagrams;
 2. Physical arrangement drawings;
 3. Unit wiring diagrams;
 4. Drawings showing space available for conduit entrance and for routing and training of cables;
 5. Schematic diagrams for electrically operated equipment; and
 6. Catalog cuts of standard catalog items.
- B.** Working Drawings. Submit working drawings including:
 1. Setting diagrams if anchoring in concrete is required;
 2. Erection diagrams if shipped in sections or if parts are shipped separately and not installed at factory; and
 3. Interconnection diagrams for circuits have externally located Instruments, controls, alarms or similar devices.
- C.** Test Reports. Submit certified test reports for all tests at the manufacturer's plant and all field tests.

0.3 QUALITY ASSURANCE

- A.** Perform the following tests at the manufacturer's plant, in addition to the manufacturer's standard tests, on the assembled switchboards:
 1. 60 Hz dielectric tests;
 2. Mechanical operations tests;
 3. Grounding of instrument;
 4. Transformer case tests;
 5. Electrical operations tests; and

6. Control wiring checks.

0.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A.** Ship equipment in assembled sections of maximum size as defined for each switchboard by the Engineer.
- B.** Temporary Bracing. Brace and package the equipment to permit hoisting, lowering, and skidding into position. Clearly label any temporary internal bracing of equipment as TEMPORARY BRACING: TO BE REMOVED BEFORE OPERATION.
- C.** Protection Against Concealed Damage. Package equipment which may be subject to non-visible damage during shipment, with mechanical impact recorders which will register the maximum acceleration to which the equipment has been subjected along each axis. Unpack such equipment in the presence of the Engineer.

PART 2 - PRODUCTS

0.1 GENERAL

- A.** Furnish distribution switchboards which are completely metal enclosed, self-supporting, dead front, free standing, circuit breaker type for indoor service and which conform to NEMA Standards No. PB-2, UL Standard No. 891, and the NEC. Enclosure frame and interior barriers shall be fabricated of not less than 11-gauge steel. Construction shall prevent entry of rodents into the interior.
- B.** Furnish switchboards consisting of the required number of vertical sections bolted together to form one rigid switchboard and incorporating switching and protective devices of the number and type rating specified herein and shown on the Contract Drawings.
- C.** Furnish switchboards completely assembled, wired and tested at the manufacturer's plant. If approved by the Engineer, switchboards may be broken down into convenient shipping sections subsequent to the completion of the tests.

0.2 RATINGS

- A.** Furnish completed switchboards rated for service on 480/277 volt, 3-phase, 4-wire, 60 Hz, power system(s) having a short circuit capacity, breaker frame sizes, number of poles, trip unit characteristics, instrument ratings, control equipment ratings, and basic insulation impulse level (BIL), all as indicated on the Contract Drawings.

0.3 PHYSICAL SIZE

- A.** Furnish switchboards of nominal 90 inches height, and of width and depth of the vertical sections adequate to accommodate and connect the equipment except where greater widths and depth are shown on the Contract Drawings. All vertical sections shall align front and rear except, subject to approval by the Engineer, rear projection may be permitted for sections containing power air circuit breakers and similar large components.

0.4 ARRANGEMENT

- A.** Arrange switchboards as service entrance and secondary distribution type, or where feasible, combine the essential bus distribution with the service entrance into one switchboard, with the nonessential distribution switchboard remaining separate.

0.5 ACCESSIBILITY

- A.** Unless otherwise specified, provide internal components which are removable from the front of the switchboard; incoming and outgoing wiring connections which are front accessible; and incoming and outgoing power wiring connections on power circuit breakers which are rear accessible.

0.6 BUSES

- A.** Electro-tin plated or silver plated copper of sufficient cross-sectional area to continuously conduct rated full load current with a temperature rise of 50 degrees C. above an ambient temperature of 40 degrees C. Brace bus bars rigidly to comply with the integrated equipment rating of the switchboard. Bus bars shall be isolated from phase-to-phase and phase-to-ground by insulating material.
- B.** Main Buses. The main horizontal bus bars shall be located at the back of the switchboard to permit a maximum of available conduit area. Extend main buses horizontally from the incoming line sections to and through distribution and motor control sections.
 1. The end section shall have bus bar provisions for future addition of a section. The provisions shall include the bus bars installed and extended to the extreme side of the section and fabricated in such a manner that the addition of a future section will require only the installation of standard bolted splice plates. The horizontal main bus bar supports, connections, and joints shall be bolted with a minimum of two bolts per joint, and shall not require periodic maintenance. Type: 4-pole including a full or one-half capacity neutral bus, as indicated.

- C. Section Buses. Extend section buses vertically from the main bus through each vertical section to the load side of each distribution device, panel board or motor starter. Bring the neutral bus in to each distribution compartment which contains a distribution device or devices supplying 4-wire or 2-wire line to neutral circuits.
- D. Ground Buses. Extend a ground bus full length through the switchboard and firmly bolt to each vertical section in at least two places. Make provision near each end of the ground bus for connection to the building grounding system. Make provision for future extension of the ground bus as specified herein.
- E. Run-Back Buses. Run-back buses shall extend the breaker load connections to the rear cable compartments. Insulate run-back buses for main and feeder breakers from the main and section buses. Mount cable lugs on the load or line side of run-back buses, as applicable.
- F. Phasing. Phase, buses A-B-C from left-to-right, top-to-bottom, and front-to-rear as viewed from the front of the switchboard.

0.7 SWITCHBOARD CONFIGURATION

- A. Provide switchboards having a high voltage incoming line section, a transformer section, and a low voltage section. Each section shall be separated from the others by steel barriers, but shall be electrically connected and physically joined to form a single, metal-enclosed structure. Where double-ended substations are indicated, there shall be two incoming line and transformer sections, and a normally-open tie breaker shall be provided in the low voltage section to allow either of the two transformers to fully handle the electrical load when an incoming feeder cable or breaker is out of service. Tiebreakers shall be key-interlocked with the main breakers. Transformers shall be ventilated dry-type. The low voltage section shall consist of three basic compartments from front to rear: the front breaker compartment, the center bus compartment, and the rear cable compartment. The front breaker compartment shall contain the drawout circuit breaker elements, each mounted in its own barriered cell. Each breaker cell shall be provided with a hinged door and handle with key lock and an external trip button. Active or future use cells equipped to accept circuit breakers shall be complete with the circuit breaker drawout mechanism and all current-carrying parts. The center bus compartment shall contain the section and main bus and isolated neutral bus. The rear cable compartment shall be sized to accommodate all incoming and outgoing cables required within each vertical switchboard section. This compartment shall also contain the run-back bus which is extended into this compartment from the bus compartment. This compartment shall also contain the ground bus bolted directly to the switchboard frame. A neutral stud shall be extended into the cable compartment in each vertical section for connection of neutral conductors. A bus connection shall be provided

for connecting the neutral to the ground bus with a removable isolating link.

0.8 POWER AIR CIRCUIT BREAKERS

- A.** Power air circuit breakers shall be drawout type, as indicated, conforming to ANSI C37.13 and C37.16. They shall have a stored energy operating mechanism to provide electrically and mechanically, trip-free closing and tripping. The breaker shall be complete with solid-state series trip devices, interpole barriers, arc-quenchers, mechanical trip button and position indicator, and shall be capable of being padlocked in the open position. Electrically operated breakers shall be provided with integral indicating lamps and push buttons and provisions for remote indication and operation. All fused power circuit breakers shall include integrally or separately mounted current limiting fuse breaker units coordinated with the overcurrent trip devices to avoid unnecessary blowing of the fuses. Fused breakers shall include blown fuse indicator which locks out the circuit breaker until the fuse is replaced and the device reset.
- B.** Each breaker shall contain an integral solid trip device, self-contained to include a power supply and trip device, and current level sensing transformers tapped for multiple current ratings. An external source of power shall not be required to trip the breaker under overload or fault conditions. The solid state sensor units shall be constructed of industrial grade components for long life, free from shifting characteristics within an ambient temperature range of minus 20 degrees C.
- C.** The breakers shall be equipped with long-time, short-time, instantaneous (and, where indicated, ground fault) trip characteristics as indicated. These trips shall be adjustable in discreet steps in the following ranges: Long-time 80-130 or 50-125 percent of trip rating, short-time delay 200-500 percent, or 400-1000 percent of trip rating. Adjustable time delay bands shall be provided. Current sensor tapes shall be provided to change trip ranges. Zero sequence ground fault trip shall have adjustment range 100-400 or 300-1200 amperes, depending on the breaker trip rating and with time delay adjustable from 0.06 to 0.3 second in discreet steps. Actual settings shall be as indicated.
- D.** The breakers shall be manufactured in accordance with NEMA SG 3 and shall be provided with under-voltage trip coils with time delay feature where indicated. Provide transformers where required to match these trip coil requirements.
- E.** A portable test set for field calibration of solid-state sensor unit and trip circuit shall be provided.
- F.** Racking mechanism. The drawout mechanism shall include a racking mechanism to lock the circuit breaker in the connected position and to overcome the mechanical resistance of making and breaking the contacts of the disconnecting devices. The mechanism shall be capable of racking

out the breaker with the compartment door closed. Positive mechanical interlocks of heavy-duty design shall prevent the breaker from being racked in or out until the breaker is open and shall prevent the breaker from being closed while being racked in or out. A positive stop with manual release shall be provided to hold the breaker in the test position and a limit stop shall be provided in the full drawout position.

- G. The stationary structure shall include a jig assembled and electrically welded compartment for each removable breaker element, with the stationary position of the primary and secondary disconnecting devices, drawout mechanism and hinged front panel, all accurately aligned to insure interchangeability of the breaker removable elements.
- H. Compartments for future breakers shall be completely equipped for the future addition of a power circuit breaker element, including necessary electrical connections. Insulated boots shall be furnished on all exposed bus stubs in any unused breaker compartments.
- I. Disconnecting devices, primary disconnecting devices for breakers rated less than 2000A shall be of the blade and finger type with silver-to-silver line pressure contacts and the blade on the stationary structure. Primary disconnecting devices for breakers rated 2000A and larger shall be the stud and socket type. The socket shall be formed of silver surfaced copper segments reinforced with non-magnetic, non-corrosive springs to produce high pressure line silver-to-silver contacts with the stud mounted on the removable element. Secondary disconnecting devices of the finger type shall be provided when required for all remote control circuits. They shall permit operation of the breaker and its accessories in the test and operating position.

0.9 MOLDED CASE CIRCUIT BREAKERS

- A. Provide molded case circuit breakers for all incoming lines and outgoing feeders except where power circuit breakers are specifically called for on the Contract Drawings.
- B. Furnish molded case circuit breakers in accordance with NEMA Standards No. AB 1. Short circuit rating of all molded case circuit breakers: equal to or greater than the maximum short circuit to which they would be subjected when directly connected to the power system specified herein. Do not apply molded case circuit breakers in a cascade system.
- C. Breakers shall have an interrupting rating not less than 14,000 amperes rms symmetrical at 480/277 volts or as otherwise indicated. The breaker trip element; enclosure compensated for temperature rise and calibrated to 40 degree C. ambient temperature.

0.10 MOTOR CONTROLS

- A.** Circuit breaker type conforming to the requirements of Section 16920 - MOTOR CONTROL CENTERS AND MOTOR STARTERS.

0.11 SMALL WIRING

- A.** Furnish small wiring, necessary fuse blocks and terminal blocks within the switchboard when required. Provide all groups of control wires leaving the switchboard with terminal blocks with suitable numbering strips. On conductors, use hardware having a high tensile strength and an anticorrosive zinc plating. Provide each terminal block with 10 percent spare wire terminals. Provide control switches and red and green indicating lights for electrically operated circuit breakers.

0.12 TERMINAL LUGS

- A.** Provide terminal lugs for all incoming and outgoing wiring including neutral and ground wires.
- B.** For power wiring, provide terminal lugs of the anti-turn, solderless type which will grip the wire firmly without damage and does not have bolts or screws which are directly in contact with the wire or cable strands.
- C.** Terminals for control wiring may be of the screw or clamp type.
- D.** Provide terminals and terminal lugs made of materials compatible with the wiring materials with which they will be used. The thermal expansion characteristics of the material in which the wiring is clamped shall be essentially identical to the wire material.
- E.** Provide terminal lugs of the sizes required for the wiring shown on the Contract Drawings.

0.13 CONDUIT SPACE

- A.** Provide conduit space for all incoming and outgoing wiring where and as shown on the Contract Drawings, adequate for terminating conduits, pulling wiring and training of wiring within the switchboard.

0.14 NAMEPLATES

- A.** Provide engraved laminated plastic nameplates for each switchboard device, with legends and colors as shown on the Contract Drawings.

- B.** Provide all switching and protective devices with permanent, visible on-off identifications and neutral position identification for devices with neutral positions.
- C.** Provide nameplates bearing equipment ratings, tap changing information, manufacturer identification, and reference serial numbers mounted on the front of distribution switchboard.

0.15 METERING EQUIPMENT

- A.** Furnish service entrance metering as shown on the Contract Drawings and conforming to requirements of the utility company.
- B.** Utility metering compartment shall be isolated by steel barriers and shall have provisions for padlocking. Obtain utility company approval of Shop Drawings, in writing, before fabrication of switchboard.

0.16 FINISHES

- A.** Clean and finish exterior and interior steel surfaces of the switchboard with gray ANSI-61 paint over a rust-inhibiting phosphatized coating, of a type to which field applied paint will adhere. Furnish the name of the manufacturer and paint number, type, or formulation of the finish paint used.

0.17 METERS

- A.** Provide ammeters and voltmeters supplied with selector switches. Meters shall be accurate to within one percent.

PART 3 - EXECUTION

0.1 GENERAL

- A.** Install, wire, and connect switchboards complete and ready for operation in accordance with these Specifications, the manufacturer's instructions, and as shown on the Contract Drawings.

0.2 WIRING AND CONDUIT WORK

- A.** Refer to Section 16050 - BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK.

0.3 GROUNDING

- A.** Refer to Section 16450 - GROUNDING.

0.4 SWITCHBOARDS INSTALLATION

- A.** Install switchboards in the locations shown on the Contract Drawings, secure, plumb and level and in true alignment with related adjoining work.
- B.** Furnish anchor bolts and anchorage items where required and field check to insure proper alignment and location. Provide templates, layout drawings, and supervision at the jobsite to insure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.
- C.** Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts, angles, as required to set and rigidly connect the work.
- D.** Provide temporary bracing, guys, or other devices as required to accomplish erection and to provide safety and stability until work is in final position and approved.
- E.** Control erection tolerance requirements so as not to impair the strength, safety, serviceability, or appearance as approved by the Engineer.
- F.** Exercise special care during construction to avoid overloading any part of the structure. Repair or replace any item damaged due to overloading to the satisfaction of the Engineer, at no additional cost to the Authority.
- G.** Align mismatched holes by reaming or replacing of clip connectors. Cutting with torches will not be permitted.

0.5 FIELD TOUCH-UP PAINTING

- A.** After installations are complete, clean thoroughly places where shop paint coating is missing or abraded, all bare steel, including bolts, nuts, washers, and welds, and paint each item with the same paint as used for shop coating in the corresponding location.

0.6 FIELD TESTS

- A.** Furnish all necessary equipment for testing all power, lighting and control circuits after installation. Test and demonstrate to the satisfaction of the Engineer the following:
 1. That all circuits are properly connected in accordance with the applicable wiring diagrams;

2. That all circuits are continuous and free from short circuits;
3. That all insulation resistance to ground of non-grounded conductors is megger tested to not less than 50 megohms;
4. That the completed equipment grounding system is megger tested at each service disconnect enclosure ground bar to ensure that the ground resistance, without chemical treatment or other artificial means, does not exceed two ohms; and
5. That all circuits are operable. Conduct tests to include operating each control not less than ten times, and the continuous operation of each lighting and power circuit for not less than one-half hour.

PART 4 - MEASUREMENT AND PAYMENT

0.1 MEASUREMENT

- A. Distribution switchboards will be measured as per each complete in place, including all preparation, accessories and incidentals.

0.2 PAYMENT

- A. Payment for distribution switchboards will be made at the Contract unit price for the quantities as specified above.

0.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
1620.011	DISTRIBUTION SWITCHBOARD	EA

END OF SECTION